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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
DOLAN, JENNIFER M	
ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 06/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/633,628	DREWES, JOEL A.	
	Examiner	Art Unit	
	Jennifer M. Dolan	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *18-60* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *18-60* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 August 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/5/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 60 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim, or amend the claim to place the claim in proper dependent form, or rewrite the claim in independent form. Claim 60 is dependent upon itself. Based on the previous claims, it is assumed by the examiner, for the purpose of examination, that claim 60 should be dependent upon claim 59.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 18, 19, 21-27, 29-36, 38-43, 53, 54, and 56-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,341,053 to Nakada et al. in view of U.S. Patent No. 6,418,048 to Sin et al.

Regarding claims 18, 26, 35, and 53, Nakada discloses an MRAM magnetic memory device (column 1, lines 5-10), comprising: a substrate (11); a second conductor (19); a pinned layer structure (17,18) connected to the second electrode (figure 1); a nonmagnetic layer (16) under the pinned structure; a sensing structure (14, 15) under the nonmagnetic layer, the sensing

structure including an antiferromagnetic layer (14) coupled to at least one ferromagnetic free layer (15); and a conductor (12) under and electrically connected with the sensing structure (figure 1).

Nakada fails to teach that the layer structure can be reversed, such that the pinned layer structure is on bottom, rather than on top of the free layer structure.

Sin teaches that both top and bottom pinned structures are well known in the art of MTJs for MRAMs (see column 1, lines 38-67; column 2, lines 11-40; figures 2 and 4; layers 36 in figure 2 and 68 in figure 4 comprise a pinned layer structure).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the MTJ structure of Nakada, such that it is formed in a bottom pinned structure, as suggested by Sin. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide both top and bottom pinned structures, because both structures are very well known and commonly used in the art. It is further well known in the art that a bottom pinned structure is disadvantageous, in that it does not have a symmetric response to an external field, but is advantageous in that it allows for a higher quality pinned structure, and thus increases the exchange coupling between the pinned and antiferromagnetic layers, leading to greater reliability (see Sin, column 1, lines 38-67; column 2, lines 11-40; figures 2 and 4). Hence, it is well within the purview of a person having ordinary skill in the art to provide the MTJ structure of Nakada in a bottom-pinned configuration, in order to take advantage of the improved reliability.

Regarding claims 19, 27, 36, and 54, Nakada discloses that the antiferromagnetic layer is FeMn, NiMn, or PtMn (column 5, lines 1-5).

Regarding claims 21, 29, 38, and 56, Nakada discloses that the antiferromagnetic layer is 50 angstroms (column 5, lines 60-65).

Regarding claims 22, 31, 40, and 57, Nakada discloses that the pinned magnetic structure comprises a plurality of layers (17, 18) including at least one pinned layer (17).

Regarding claims 30 and 39, Nakada discloses that the second free magnetic structure includes at least one sense layer (15).

Regarding claims 23, 32, 41, and 58, Nakada discloses that the nonmagnetic layer comprises aluminum oxide (column 5, lines 17-22; column 6, lines 1-5).

Regarding claims 24, 25, 33, 34, 42, 43, 59, and 60, Nakada discloses that the antiferromagnetic layer provides bias to the free layer, and that the exchange field between the layers is less than the shape dependent coercivity of the element (column 2, lines 20-39; column 3, lines 1-29; exchange coupling must be low, since the structure is substantially similar to that of the applicant, and since the free layer is still free to rotate in the presence of an external field).

4. Claims 44, 45 and 47-52 rejected under 35 U.S.C. 103(a) as being unpatentable over Nakada et al. in view of Sin et al. and U.S. Patent No. 6,456,525 to Perner et al.

Regarding claim 44, Nakada discloses an MRAM magnetic memory device (column 1, lines 5-10), comprising: a substrate (11); a second conductor (19); a pinned layer structure (17,18) connected to the second electrode (figure 1); a nonmagnetic layer (16) under the pinned structure; a sensing structure (14, 15) under the nonmagnetic layer, the sensing structure including an antiferromagnetic layer (14) coupled to at least one ferromagnetic free layer (15); and a conductor (12) under and electrically connected with the sensing structure (figure 1).

Nakada fails to teach that the layer structure can be reversed, such that the pinned layer structure is on bottom, rather than on top of the free layer structure. Nakada further fails to explicitly teach an MRAM system including a process and IC having MRAM elements.

Sin teaches that both top and bottom pinned structures are well known in the art of MTJs for MRAMs (see column 1, lines 38-67; column 2, lines 11-40; figures 2 and 4; layers 36 in figure 2 and 68 in figure 4 comprise a pinned layer structure).

Perner teaches an MRAM having a processor (456) and an IC comprising MRAM elements (see figure 10).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the MTJ structure of Nakada, such that it is formed in a bottom pinned structure, as suggested by Sin, and to include a processor and IC elements, as suggested by Perner et al. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide both top and bottom pinned structures, because both structures are very well known and commonly used in the art. It is further well known in the art that a bottom pinned structure is disadvantageous, in that it does not have a symmetric response to an external field, but is advantageous in that it allows for a higher quality pinned structure, and thus increases the exchange coupling between the pinned and antiferromagnetic layers, leading to greater reliability (see Sin, column 1, lines 38-67; column 2, lines 11-40; figures 2 and 4). Hence, it is well within the purview of a person having ordinary skill in the art to provide the MTJ structure of Nakada in a bottom-pinned configuration, in order to take advantage of the improved reliability. A person skilled in the art would further have specified that a processor and IC with MRAMs are present in the structure, because MRAM arrays require IC structures in

order to allow for reading and writing operations, and MRAMs are typically used with processor-containing devices, such as computers or digital cameras (see Perner, column 8, lines 50-67; figures 1, 4-6, and 10).

Regarding claim 45, Nakada discloses that the antiferromagnetic layer is FeMn, NiMn, or PtMn (column 5, lines 1-5).

Regarding claim 47, Nakada discloses that the antiferromagnetic layer is 50 angstroms (column 5, lines 60-65).

Regarding claim 48, Nakada discloses that the second free magnetic structure includes at least one sense layer (15).

Regarding claim 49, Nakada discloses that the pinned magnetic structure comprises a plurality of layers (17, 18) including at least one pinned layer (17).

Regarding claim 50, Nakada discloses that the nonmagnetic layer comprises aluminum oxide (column 5, lines 17-22; column 6, lines 1-5).

Regarding claims 51 and 52, Nakada discloses that the antiferromagnetic layer provides bias to the free layer, and that the exchange field between the layers is less than the shape dependent coercivity of the element (column 2, lines 20-39; column 3, lines 1-29; exchange coupling must be low, since the structure is substantially similar to that of the applicant, and since the free layer is still free to rotate in the presence of an external field).

5. Claims 20, 28, 37, and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakada et al. in view of Sin et al. as applied to claims 18, 26, 35, and 53 above, and further in view of U.S. Patent No. 6,542,341 to Carey et al.

Nakada fails to suggest that the antiferromagnetic layer includes a synthetic structure.

Carey discloses that an antiferromagnetic layer directly biasing a free layer can equivalently be provided as an antiferromagnetic layer (figure 3, layer 52) or as a synthetic antiferromagnetic layer structure (figure 5), the structure including two ferromagnetic layers (82 and 84) separated by a metal (86).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the antiferromagnetic layer of Nakada as modified by Sin, such that the antiferromagnetic layer includes a synthetic AF structure, as suggested by Carey. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use a synthetic antiferromagnetic layer, because Carey shows that single layer antiferromagnetic layers and synthetic antiferromagnetic layers are recognized art equivalents, and may be used interchangeably for directly biasing a free layer of a tunnel junction sensor (see Carey, column 3, lines 40-67; column 5, lines 38-46; column 8, lines 1-6; figures 3-5).

6. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakada et al. in view of Sin et al. and Perner et al. as applied to claim 44 above, and further in view of Carey et al.

Nakada fails to suggest that the antiferromagnetic layer includes a synthetic structure.

Carey discloses that an antiferromagnetic layer directly biasing a free layer can equivalently be provided as an antiferromagnetic layer (figure 3, layer 52) or as a synthetic antiferromagnetic layer structure (figure 5), the structure including two ferromagnetic layers (82 and 84) separated by a metal (86).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the antiferromagnetic layer of Nakada as modified by Sin and Perner, such that the antiferromagnetic layer includes a synthetic AF structure, as suggested by Carey. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use a synthetic antiferromagnetic layer, because Carey shows that single layer antiferromagnetic layers and synthetic antiferromagnetic layers are recognized art equivalents, and may be used interchangeably for directly biasing a free layer of a tunnel junction sensor (see Carey, column 3, lines 40-67; column 5, lines 38-46; column 8, lines 1-6; figures 3-5).

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. U.S. Patent No. 6,700,760 to Mao and U.S. Patent No. 6,282,069 to Nakazawa et al. disclose magnetoresistive elements having an antiferromagnetic layer exchange-coupled to a free layer.

b. U.S. Patent Publication No.2002/0154455 to Lenssen discloses a TMR structure for a MRAM substantially similar to the claimed invention, except that the conductor layers are not specifically disclosed.

c. U.S. Patent No. 5,640,343 to Gallagher et al. discloses an MRAM having a processor and MTJ memory cells provided in an IC.

d. U.S. Patent No. 6,655,006 to Pinarbasi teaches that both top-pinned and bottom-pinned MTJ elements are well known in the art.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd

Craig A. Thompson

CRAIG A. THOMPSON
PRIMARY EXAMINER